

Structure preserving model order reduction of non-dissipative problems

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Model order reduction allows to efficiently solve parameterized differential equations in computationally intensive scenarios, such as real-time and many-query simulations. The gist is to replace the original problems with models of significantly reduced dimensionality without compromising the overall accuracy. In the case of time-dependent non-dissipative problems standard formulations of reduced models do not generally guarantee preservation of the geometric structure underlying the physical properties of the original system, like symmetries, invariants, and conservation laws. This may result in the onset of spurious artifacts and instabilities. After a brief introduction to reduced order models, we discuss and analyze structure preserving reduced basis methods for non-dissipative problems by resorting to their formulation as Hamiltonian systems endowed with a nonlinear Poisson manifold structure. Time permitting, we subsequently consider nonlinear structure preserving reduced models where the reduced phase space evolves in time. This allows to effectively cope with the local low-rank nature of the non-dissipative dynamics characterizing e.g. wave-type and advection problems.

This talk is based on a joint work with Jan S. Hesthaven.